WHAT IS CLAIMED IS:

1. A method of video contrast enhancement comprising:

    setting a first pixel level threshold for an input video frame in a video sequence;

    when a given input-video-frame pixel's level is below the pixel level threshold,

5   remapping that pixel according to an adaptive contrast-enhancing function; and

    when the given input-video-frame pixel's level is above the pixel level threshold,

    remapping that pixel according to a scene-stable mapping function.

2. The method of claim 1, wherein the adaptive contrast-enhancing function applies

10 instead when the given pixel's level is above the threshold, and the scene-stable function

    applies instead when the given pixel's level is below the threshold.

3. The method of claim 1, further comprising:

    setting a second pixel level threshold for an input video frame, the second

15 threshold higher than the first; and

    when a given input-video-frame pixel's level is above the second pixel level

    threshold, remapping that pixel to a new level according to a second adaptive contrast-

    enhancing function.

20 4. The method of claim 1, wherein setting a first pixel level threshold comprises

    setting a threshold that places a selected percentage of the input video frame's pixels below

    the threshold.

5. The method of claim 4, wherein the threshold is estimated from pixel values

25 obtained from one or more previous input video frames.

6. The method of claim 1, wherein setting a first pixel level threshold comprises setting the threshold to a fixed level for at least the duration of a scene.

5   7. The method of claim 1, further comprising calculating the adaptive contrast-enhancing function to remap an input histogram for pixels below the pixel level threshold to a new histogram specification.

8. The method of claim 7, wherein the new histogram specification is a uniform
10 distribution.

9. The method of claim 7, further comprising tabulating the input histogram from the pixels of the input video frame.

15 10. The method of claim 7, further comprising tabulating the input histogram from the pixels of one or more previous input video frames in the video sequence.

11. The method of claim 10, wherein tabulating the input histogram comprises maintaining each bin of the input histogram by exponentially time-filtering a corresponding
20 bin as calculated for sequential frame histograms, each frame histogram representing one frame in the video sequence.

12. The method of claim 7, wherein calculating the adaptive contrast-enhancing function is performed once for every input video frame.

25

13. The method of claim 7, wherein the adaptive contrast-enhancing function has a pixel level output range different than the range of input pixel levels below the pixel level threshold.

5   14. The method of claim 1, wherein remapping for pixels both below and above the first pixel level threshold comprises using a pixel's level as an index to read a value from a common lookup table that combines the adaptive contrast-enhancing function and the scene-stable remapping function.

10   15. The method of claim 1, further comprising detecting substantial changes in scene histogram content from one frame of the video sequence to a following frame.

16. The method of claim 15, further comprising, when a substantial change in scene histogram content is detected, allowing the adaptive contrast-enhancing function to change

15   more rapidly than it is otherwise allowed to change.

17. The method of claim 15, further comprising, when a substantial change in scene content is detected, allowing the scene-stable remapping function to change substantially.

20   18. The method of claim 1, wherein the scene-stable mapping function remaps a pixel to an output level that is a linear function of that pixel's input level.

19. An apparatus comprising a computer-readable medium containing computer instructions that, when executed, cause a processor or multiple communicating processors to

25   perform a method for video contrast enhancement comprising:

setting a first pixel level threshold for an input video frame in a video sequence;

when a given input-video-frame pixel's level is below the pixel level threshold, remapping that pixel according to an adaptive contrast-enhancing function; and

when the given input-video-frame pixel's level is above the pixel level threshold, remapping that pixel according to a scene-stable mapping function.

20. The apparatus of claim 19, the method further comprising calculating the adaptive contrast-enhancing function to remap an input histogram for pixels below the pixel level threshold to a new histogram specification.

21. A video contrast enhancer comprising:

a contrast-enhancing function generator capable of accepting a target histogram specification and a set of histogram bins derived from one or more frames of a video sequence, the bins representing a histogram at least for pixel levels below a selected pixel level threshold, the function generator capable of generating a remapping function for input pixel levels below the threshold based on the target histogram specification and the set of histogram bins; and

a scene-stable mapper to control the remapping function for input pixel levels above the threshold.

22. The video contrast enhancer of claim 21, further comprising a pixel remapper capable of accepting a pixel level from an input video frame and outputting a corresponding remapped pixel level according to the remapping function.

23. The video contrast enhancer of claim 22, wherein the pixel remapper comprises a

lookup table indexed by input pixel level, the lookup table supplying the remapped pixel

level according to the remapping function.

24. The video contrast enhancer of claim 21, further comprising a histogram

5   calculator capable of constructing a frame histogram for the input video frame.

25. The video contrast enhancer of claim 24, wherein the bins of the frame histogram

are supplied to the contrast-enhancing function generator as the set of histogram bins.

10   26. The video contrast enhancer of claim 24, further comprising a temporal histogram

filter to supply the set of histogram bins for use by the contrast-enhancing function generator,

each bin comprising an exponentially time-filtered combination of sequential frame

histograms from the histogram calculator.

15   27. The video contrast enhancer of claim 26, further comprising a scene change

detector capable of detecting scene changes based on a comparison of successive frame

histograms from the histogram calculator and supplying a scene change signal when a scene

change is detected in the video sequence, the temporal histogram filter applying a different

time constant when the scene change signal is asserted.

20

28. The video contrast enhancer of claim 21, further comprising a threshold calculator

to calculate the set threshold to correspond to a selected percentage of the pixels represented

in the histogram bins.

25   29. The video contrast enhancer of claim 21, wherein the scene-stable mapper

controls the remapping function to at least approximate a linear function of input pixel level.

30. The video contrast enhancer of claim 21, further comprising:

a histogram calculator capable of constructing a frame histogram for an input

5   video frame;

a frame buffer capable of buffering an input video frame until a remapping

function can be calculated for that frame; and

a pixel remapper capable of accepting a pixel level from the buffered input video

frame and outputting a corresponding remapped pixel level according to the remapping

10   function.

31. The video contrast enhancer of claim 21, wherein the contrast-enhancing function

generator is also capable of generating a remapping function for input pixel levels above a

second selected pixel level threshold higher than the first threshold, based on the target

15   histogram specification and the set of histogram bins, and wherein the scene-stable mapper

controls the remapping function for input pixel levels between the two thresholds.

32. A digital video device comprising:

a partial-histogram contrast enhancer to accept a digital video frame sequence and

20   remap the pixel levels in each frame using a remapping that conforms a histogram derived

from the frame sequence to a new histogram specification for pixel levels below a first pixel

level threshold;

means for setting the first pixel level threshold; and

means for enabling the partial-histogram contrast enhancer.

25

33. The digital video device of claim 32, wherein the means for setting the first pixel

level threshold comprises a threshold selector from the group consisting of a control that

allows a user to set a threshold parameter, an auto-threshold selector that sets a threshold

parameter based on the histogram derived from the frame sequence, and combinations

5   thereof.

34. The digital video device of claim 32, wherein the type of the device is a type

selected from the group consisting of a digital video camera, an analog-to-digital video

transfer device, a digital video editing device, a digital video compressor, a digital video

10   decompressor, a digital video receiver, a digital video playback device, and a digital video

display device.

35. The digital video device of claim 35, wherein the histogram derived from the

frame sequence is supplied to the digital video device along with the digital video frame

15   sequence.